Land Mapping Satellites (Landsat)

The National Aeronautics & Space Administration (NASA) launched the first satellite designed to provide repetitive global coverage of the Earth's land masses in July, 1972. Since the Landsat1 launch, other Landsats have been placed into orbit and have provided nearly continual land mapping coverage of the Earth from 1982 to the present.

The source of the image on the opposite page is Landsat5. This NASA satellite was launched from Point Arguello, California on March 4, 1984, and it flies in a repetitive orbit that takes 16 days to return to the same location. The satellite orbits at 423 miles above the Earth, and each somewhat over-lapping image covers an area, 106 miles by 115 miles (12,190 square miles).

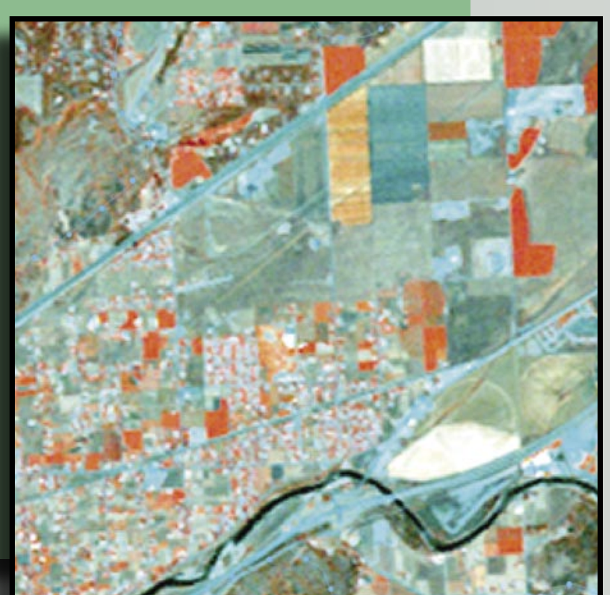
The United States Geological Survey (USGS) manages the Landsat data archive. This archive contains a detailed collection of information about the land surface of our planet. Major changes to the land surface can be detected and analyzed with Landsat data. Governments, businesses and educational institutions world-wide have employed Landsat data for a variety of applications including mapping, geography, geology, oceanography, agriculture and forestry.

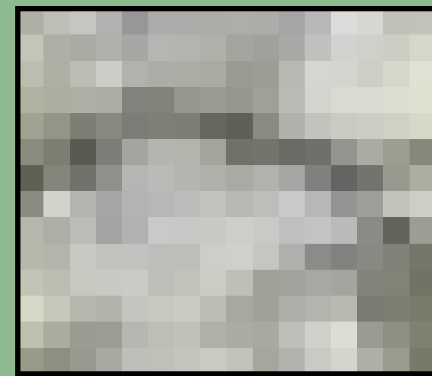
Image or Photograph?

Satellite imagery can LOOK like photography, but satellite imagery is actually one or a combination of the seven data sets (called spectral bands) collected by the satellite's data collector, a thematic mapper multispectral scanning radiometer. The spectral bands are Band 1, red; Band 2, green; Band 3, blue; Band 4, mid infra-red; Band 5, near infra-red; Band 6, thermal; and, Band 7, far infra-red. Each data point, or "pixel," of the spectral imagery represents 30 square meters.

Images are created by using one or more of the spectral bands collected by the satellite's thematic mapper. The data (pixels) from the spectral bands are organized in a digital grid, and colors are assigned to value ranges in each pixel. By carefully constructing a color palette for the pixel values, a satellite image can be made that looks very much like a photograph.

The image at right contains multi-band data with emphasis on the infra-red spectrum. The data set used to create this image was collected at the same time (2003) as the data used to make the aquifer image on the opposite page.





The image at left is a section of the 2003 satellite image on the opposite page at the Idaho-Washington border where Interstate 90 crosses the Spokane River that has been enlarged 10 times. As you can see the image is comprised of colored squares, called "pixels." A pixel represents a data point 30 meters (98 feet) square collected by Landsat5, and each pixel is about 0.22 acres. The entire image is 16 pixels (1,575 feet) wide and 14 pixels (1,378 feet) high with an area of about 50 acres.

Change Mapping

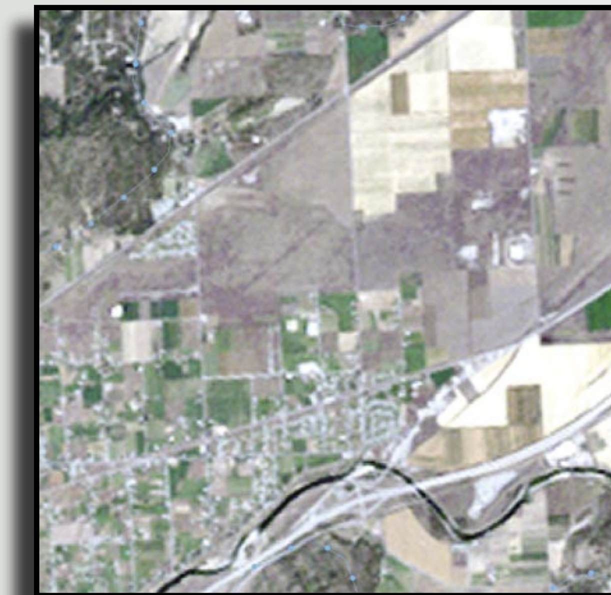
Since each pixel in a digital image has a numeric value, images collected at different times can be compared, pixel by pixel. At the top right are two Landsat images over the Aquifer at the Idaho-Washington border collected in 1986 and 2003. The 2003 image is the same data set as the image on the opposite page.

These two images were compared, pixel by pixel, using a sophisticated computer program to assess the change in vegetation on the land surface over seventeen years, and a four color comparison map was produced. If the 2003 pixel had a spectral value that indicated significantly LESS VEGETATION than the comparable 1986 pixel, then that pixel was assigned a red color on the comparison map. If the 2003 pixel had a spectral value that indicated significantly MORE VEGETATION than the comparable 1986 pixel, then that pixel was assigned a yellow color on the comparison map. If the 2003 pixel and the 1986 pixel had about the same value, then that pixel was assigned a green color. Impervious surfaces present on both images were assigned a gray color.

While the change map is interesting, it is not possible to generalize the results without field verification: the red pixels do not in all cases represent vegetation lost to development, and the green pixels do not in all cases represent vegetation "gained." For example, if a field was green with vegetation in the 1986 image, and in 2003 contained a subdivision, most of the field area would be red in the change map. However, if the field was fallow with no vegetation in the 1986 image, and in 2003 contained a subdivision, most of the field area would be green in the change map due to the subdivision landscaping.

The final image is a composite of the red pixels from the change map with the 2003 image. This image shows where the pixel comparison program indicates less vegetation in 2003 when compared to 1986.

1986



2003